The absorption spectrum at 77°K (figure 2) shows that $^5T_{2g} \rightarrow {}^5E_g$ band splits into two components at 5210 cm^{-1} and 6370 cm^{-1}. This splitting is presumably due to the Jahn-Teller distortion of the upper ^5E_g state. The lack of polarisation of the bands agrees with this asignment. The separation of 1160 cm^{-1} of the components, which measures the magnitude of the Jahn-Teller distortion, is less than that observed for Fe^{2+} surrounded by an octahedron of $(OH)^-$ ions ($\sim$2000 cm^{-1} Liehr & Ballhausen 1958). This is in conformity with the low strength of the crystal field in the present case

In addition, we have observed a band at 25040 cm^{-1} with high extinction coefficient. This is ascribed to the charge-transfer transition involving transfer of an electron from the Cl-ligand to the metal ion. In the molecular orbital scheme it is assigned to the transition (figure 3) t_{2u} (ligand)$\rightarrow t_{2g}$ (metal). The direct product of $t_2 \times t_2$ breaks into T_1, T_2, A_1, A_2 Under C_{3v} symmetry there should be three transitions polarised perpendicular to C and one transition polarised along C From the observed polarised spectrum at 77°K (figure 2) it is seen that there are two transitions in the $C_\perp$ direction at 25160 cm^{-1} and 24390 cm^{-1} and there is one transition at 25565 cm^{-1} in the $C_\parallel$ direction The magnitude of the trigonal field splitting is estimated to be nearly 400 cm^{-1}

The authors have undertaken the magnetic susceptibility and anisotropy measurement to corroborate the above finding.

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Indian J. Phys. **44**, 60–63, (1970)

Statistically linear mass relation of elementary particles and its representation by a polynomial curve fitting equation

By B. J Bhattacharjee

St. Anthony's College, Shillong, India

(*Received* 31 *March—Revised* 21 *July* 1970)

It is found that when the atomic weights of elements are plotted against the atomic numbers, a parabolic curve is obtained for the first 86 elements which however does not hold for the rest of the elements (figure 1). In the case of elementary

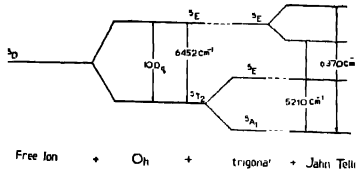

Figure 1. Splitting scheme for $(3d)^6$ (a) octahedral field (b) trigonal field and (c) Jahn-Teller field.

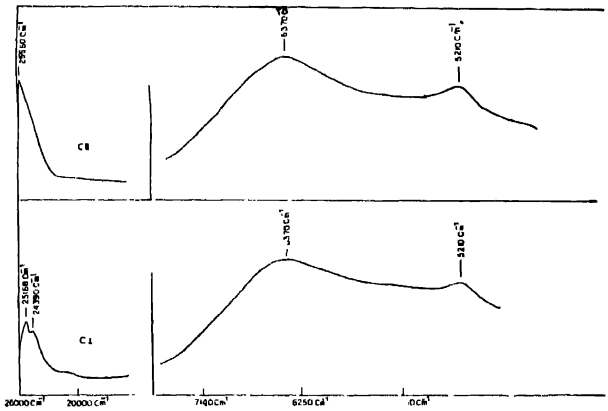

Figure 2. Polarised absorption spectra of Fe^{2+} in $CsCdCl_3$ at 77°K.

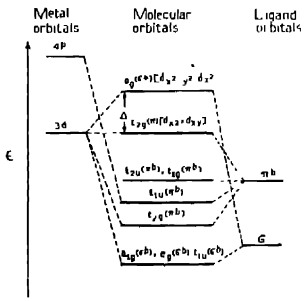

Figure 3. Molecular orbital energy level diagram for metal hexachlorides.

particles it seems to us (Bhattacharjee 1970) that excluding photon family, as their rest mass is zero or nearly so, we may ascribe a number for each elementary particle in the order of increasing mass. Let us call this number as 'Elementary particle number' (E.P.No.), as in the case of atomic number of elements. However, its physical meaning remains to be clarified. Plotting this number against respective 'Rest Mass' (R.M.) we find a parabolic curve (figure 2a). Thus the majority of elementary particles can be represented by a single curve. The overall symmetry of the curve suggests that there is a definite relation between E.P No. and R.M. of the particles. It is true that a few points exhibit large deviations from the fundamental curve. These deviations can perhaps be eliminated if we have more elementary particles in these regions. On this basis, after postulating 9 more particles (Set 2), we have drawn the curve 2(*b*) which shows an overall symmetry.

The following numbers indicate the R.M. in MEV of Elementary particles :

For figure 2a. (Set 1) : .511(e), 106(μ), 137(π), 496(κ), 548(η), 750($d\pi$), 782(η), 888(κ), 937(N), 1020(η), 1115(Λ), 1193(Σ), 1238(Δ), 1250(η), 1290(π), 1318(Ξ), 1385(Σ), 1405)(Λ), 1515(κ), 1512(N), 1520(Λ), 1530(Ξ), 1605(Ξ), 1660(Σ), 1676(Ω), 1688(N), 1815(Λ), 1860(η), 1890(Σ), 1920(Δ), 1980(Ξ), 2015(Λ);

For figure 2b (Set 2) : 0.511, 106, 137, 220p, 300p, 370p, 430p, 496, 548, 640p, 700p, 750, 782, 888. 939, 1020, 1060p, 1115, 1193, 1238, 1250, 1290, 1318, 1385, 1405, 1450, 1512, 1520, 1530, 1600, 1660, 1676, 1700, 1725p, 1775p, 1815, 1860, 1890, 1920, 1980, 2020

(Numbers associated with p are the particles postulated and other symbols have the conventional meaning).

The curves that have been drawn from considerations of the similarity in behaviour between elements and elementary particles agree well figuratively. We believe that the interpretation of the data indicates a compelling evidence that the linear mass relation should be given by a polynomial curve fitting equation, viz.

$$Y = A + BX + CX^2 + DX^3 \ldots$$

where Y is *E.P. No*, X is *R.M*, A, B, C, D etc are constants. Obviously our prime interest will be the values of A, B, C etc. The values as obtained by electronic computer are given in table 1 for elements and elementary particles.

It is reasonable to expect that the values should fit into the above equation. Unfortunately the agreement is not good. The aim of this report, however, is to show (1) that the above is a novel method of approach, and (2) that the actual values of A, B, C, etc may offer some insight into the internal structure of elementary particles. Moreover (3) there is a purely statistical relation for elementary

particles and (4) also some similarity between elements and elementary particles, both being amenable to a curve fitting equation.

Table 1a. For elements

	2nd order	3rd order	4th order	5th order
A	−1.22831800	1.66207100	.38558000	−1.13840700
B	2 07051030	1.67414130	1.96004910	2.45843820
C	.00587743	.01746495	.00250491	−.03775392
D		−.00009085	.00018220	.00143930
E			−.00000160	−.00001826
F				.00000007

Table 1b. For elementary particles

Set I	2nd order	3rd order	4th order	5th order
A	24.38707000	−215.30540000	−277.63580000	−219.49380000
B	106 76421000	187.76053000	220 96462000	177.46715000
C	−1.50055740	−7.54324520	−11.91073600	−3.24074600
D		.12207461	.32579282	−.35805610
E			−.00308669	.02003633
F				−.00028028
Set II	**2nd order**	**3rd order**	**4th order**	**5th order**
A	−56.13346000	−102.51284000	−52.32042000	−43.59700000
B	74.73282300	87.23702000	65.66401000	60.32073600
C	−.62255894	−1 35796390	.88921120	1.73883200
D		.01167310	−.07087805	−.12388310
E			.00098278	.00239492
F				−.00001345

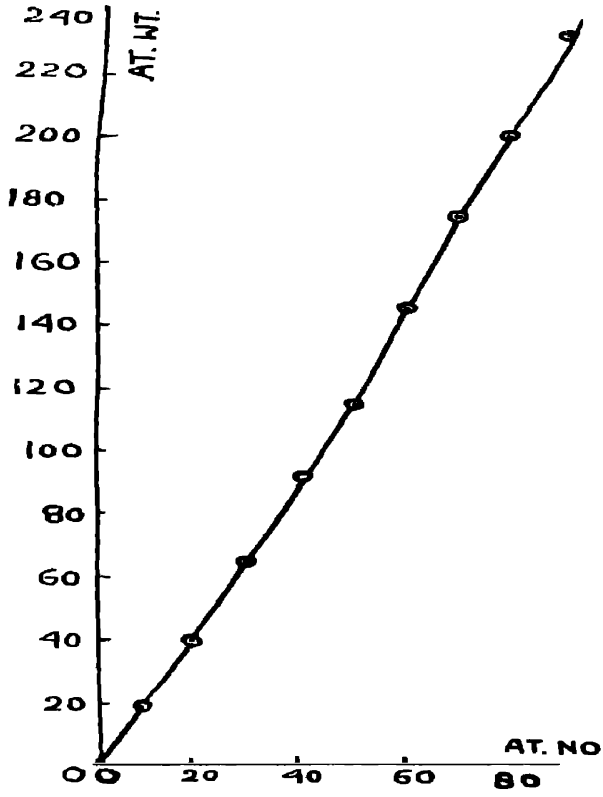
240
220
200
180
160
140
120
100
80
60
40
20
0
AT. WT.
0
20
40
60
80
AT. NO

Fig. 1.

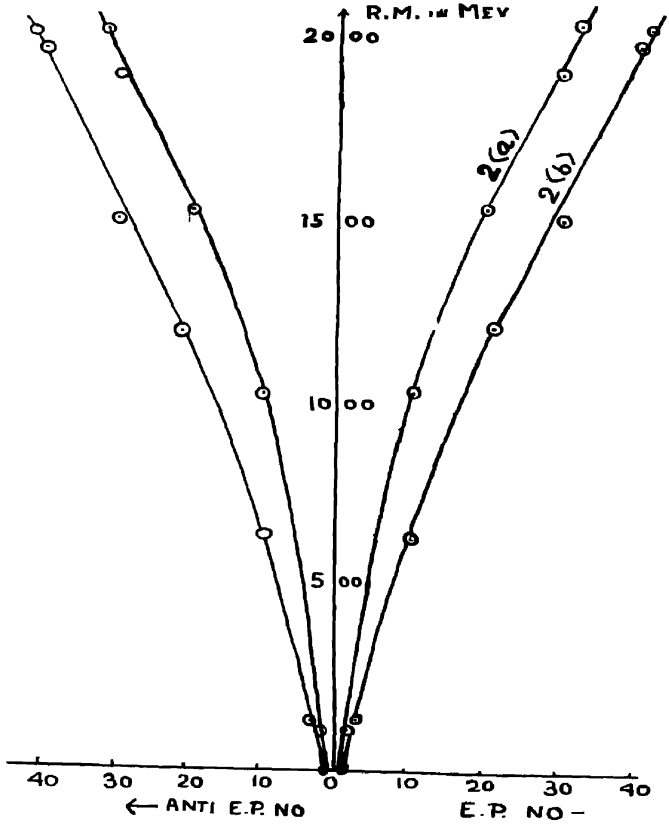
R.M. in MEV
20 00
15 00
10 00
5 00
2(a)
2(b)
40
30
20
10
0
10
20
30
40
← ANTI E.P. NO
E.P. NO →

Fig. 2.

The author is thankful to Dr. G. P. Bhattacharjee and Dr. S. K. Dutta Roy for their interest and help in the work. He also thanks the authorities of the Indian Institute of Technology, Kharagpur, India, for providing facilities for using the electronic computer.

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Indian J. Phys. **44**, 63–,65 (1970)

Hydrogen excitation in H-α collision by second Born approximation

BY JAYASRI CHOWDHURY (nc6) SEN AND D. M. BHATTACHARYA

Department of Theoretical Physics,
Indian Association for the Cultivation of Science, Calcutta—32

(*Received* 31 *March* 1970)

Previous investigations on the excitation of atomic hydrogen by alpha particle have been made by Bates (1959). Using the impact parameter treatment he has shown that the introduction of allowance for distortion leads to much smaller cross-sections than those obtained by the first Born approximation at low and moderate energies. The purpose of our present work is to investigate the same problem in the second Born approximation and to compare our findings with the previous results.

We consider α-particle B to be moving with a constant velocity v in a straight line and the target nucleus to be at rest at A. The Hamiltonian H corresponding to the motion of the electron is given by

$$H = -\tfrac{1}{2}\nabla^2 - \frac{1}{r_A} - \frac{2}{r_B} \quad \text{(in atomic units)}$$

The total electronic wave function may be represented by the expansion

$$\Psi(r, t) = \sum_n a_n(t)\psi_n$$

where $\psi_n = \phi_n(r)\exp(-i\epsilon_n t)$,

$\phi_n(r)$ and ϵ_n being the eigenfunctions and eigenenergies of the hydrogen atom.